

## CLAIMS

What is claimed is:

- 1 1. A resilient electronic interconnection element comprising:  
2 a first structure of a first material having a first spring  
3 constant, the first structure capable of being free-standing by  
4 itself, the first spring constant high enough for repeated  
5 elastic displacement without substantial plastic deformation;  
6 and  
7 a second structure of a lithographically-patterned second  
8 material coupled to the first material such that the first  
9 material and the second material together have a second spring  
10 constant greater than the first spring constant,  
11 wherein the interconnection element is adapted to be  
12 coupled to an electronic component to act as a conductive path.
- 1 2. The interconnection element of claim 1, wherein the second  
2 spring constant is greater than approximately 0.2 gram-force per  
3 mil.
- 1 3. The interconnection element of claim 1, wherein at least  
2 one of the first material and the second material comprises a  
3 material that is electrically conductive.

1 4. The interconnection element of claim 1, wherein the second  
2 structure and the second spring constant are suitable for direct  
3 connection to a semiconductor device.

1 5. The interconnection element of claim 1, wherein the second  
2 structure and the second spring constant are suitable for chip-  
3 scale packaging.

1 6. The interconnection element of claim 1, wherein the second  
2 material overlies the first material.

1 7. The interconnection element of claim 6, wherein a portion  
2 of the second structure conforms to the first structure.

1 8. The interconnection element of claim 5, wherein the  
2 interconnection element has a shape which comprises an anchor  
3 portion coupled to an electronic component and a free-standing  
4 portion connected to the anchor portion.

1 9. The interconnection element of claim 8, further comprising  
2 a contact tip structure coupled to the free-standing portion.

1 10. The interconnection element of claim 9, further comprising:  
2 an insulating material overlying a portion of the free-  
3 standing portion and a conductive material overlying the

4 insulating material and electrically coupled to the electronic  
5 component.

1 11. The interconnection element of claim 1, wherein the first  
2 structure has a plurality of layers of material and an inherent  
3 stress gradient.

1 12. An interconnection element comprising:  
2 a first structure of a first material formed by  
3 lithographic techniques and having a first spring constant, the  
4 first structure capable of being free-standing by itself, the  
5 first spring constant high enough for repeated elastic  
6 displacement without substantial plastic deformation; and  
7 a second structure of a lithographically-patterned second  
8 material coating a portion of the first material,  
9 wherein the interconnection element collectively has a  
10 greater spring constant than a spring constant of the first  
11 structure and is adapted to be coupled to an electronic  
12 component to act as a conductive path from the electronic  
13 component.

1 13. The interconnection element of claim 12, wherein at least  
2 one of the first material and the second material comprises a  
3 material that is electrically conductive.

1 14. The interconnection element of claim 12, wherein the second  
2 material overlies the first material.

1 15. The interconnection element of claim 14, wherein a shape of  
2 the second structure conforms to a shape of the first structure.

1 16. The interconnection element of claim 15, wherein the  
2 interconnection element has a shape which comprises an anchor  
3 portion adapted to be coupled to an electronic component and a  
4 free-standing portion connected to the anchor portion.

1 17. The interconnection element of claim 16, wherein a portion  
2 of the free-standing portion comprises a contact portion, and  
3 further comprising:

4 an insulating material overlying a portion of the free-  
5 standing portion and a conductive material overlying the  
6 insulating material and electrically coupled to the electronic  
7 component.

1 18. The interconnection element of claim 12, wherein the first  
2 structure comprises a plurality of layers of material and a  
3 stress gradient.

1 19. An electronic assembly comprising:  
2 a substrate having a plurality of conductive signal lines  
3 formed adjacent the substrate;  
4 a plurality of free-standing resilient electronic  
5 interconnection elements coupled to the signal lines, each  
6 interconnection element comprising:  
7 a first structure of a first material having a first  
8 spring constant, the first structure capable of being free-  
9 standing by itself, the first spring constant high enough for  
10 repeated elastic displacement without substantial plastic  
11 deformation, and  
12 a second structure of a lithographically-patterned  
13 second material coupled to the first material such that the  
14 first material and the second material together have a second  
15 spring constant greater than the first spring constant.

1 20. The electronic assembly of claim 19, wherein the shape of  
2 each of the plurality of interconnection elements comprises an  
3 anchor portion adapted to be coupled to the substrate and a free  
4 portion.

1 21. The electronic assembly of claim 20, wherein a portion of  
2 each of the free-standing portions of each of the plurality of

3 interconnection elements comprises a contact tip portion,  
4 further comprises:  
5 an insulating material overlying a portion of the free-  
6 standing portion and a conductive material overlying the  
7 insulating material and electrically coupled to the electronic  
8 component.

1 22. An electronic assembly including a plurality of the  
2 interconnection elements, the assembly comprising:  
3 a substrate,  
4 a plurality of signal lines associated with the substrate,  
5 a plurality of the interconnection elements, each  
6 interconnection element comprising:  
7 a first structure of a first material having a first  
8 spring constant, the first structure capable of being free-  
9 standing by itself, the first spring constant high enough for  
10 repeated elastic displacement without substantial plastic  
11 deformation, and  
12 a second structure of a second material coupled to the  
13 first material by lithographic techniques such that the first  
14 material and the second material together have a second spring  
15 constant greater than the first spring constant, with selected  
16 ones of the plurality of interconnection elements electrically  
17 connected to selected ones of the plurality of signal lines.

1 23. An electronic system comprising:  
2 a first electronic component comprising:  
3 a substrate,  
4 a plurality of signal lines associated with the  
5 substrate,  
6 a plurality of the interconnection elements, each  
7 interconnection element comprising:  
8 a first structure of a first material having a  
9 first spring constant, the first structure capable of being  
10 free-standing by itself, the first spring constant high enough  
11 for repeated elastic displacement without substantial plastic  
12 deformation, and  
13 a second structure of a second material coupled  
14 to the first material by lithographic techniques such that the  
15 first material and the second material together have a second  
16 spring constant greater than the first spring constant, with  
17 selected ones of the plurality of interconnection elements  
18 electrically connected to selected ones of the plurality of  
19 signal lines; and  
20 a second electronic component connected to the first  
21 electronic component.

1 24. A method of making electrical contact between two  
2 components comprising:

3 coupling a first component having one or more of the  
4 interconnection elements of claim 1 formed on a surface thereof  
5 to contact pads of a second component to establish a conductive  
6 path between the first component and the second component.

1 25. The method of claim 24, wherein the coupling is one of a  
2 temporary connection and a permanent connection.

1 26. The method of claim 25, wherein the coupling comprises:  
2 aligning the first component and the second component such  
3 that the one or more interconnection element is elastically  
4 displaced.

1 27. A method comprising:

2 forming a first structure coupled to a substrate, the first  
3 structure comprising a first material having a first spring  
4 constant, the first structure capable of being free-standing by  
5 itself, the first spring constant high enough for repeated  
6 elastic displacement without substantial plastic deformation, an  
7 internal stress to define a shape suitable as an interconnection  
8 in an integrated circuit environment; and

9 coating a second structure to the first structure,

10 wherein collectively the first structure and the second  
11 structure comprise an interconnection element having a spring  
12 constant greater than a spring constant of the first structure.



1 28. The method of claim 27, wherein coating the second  
2 structure comprises overlying a portion of the first structure.

1 29. The method of claim 27, wherein the substrate is a first  
2 substrate, the method further comprising transferring the  
3 interconnection element from the first substrate to a second  
4 substrate.

1 30. A method, comprising:  
2       patterning a masking material over a substrate having an  
3 opening to a conductive signal line formed on the substrate;  
4       creating a first structure of a first material into the  
5 opening having a first spring constant, the first structure  
6 capable of being free-standing by itself, the first spring  
7 constant high enough for repeated elastic displacement without  
8 substantial plastic deformation having a base coupled to a  
9 substrate and a free end extending over a portion of the masking  
10 material; and  
11       coating a second structure to the first structure to  
12 increase the spring constant of the structure; and  
13       removing the masking material.

1 31. The method of claim 30, wherein creating the first  
2 structure further comprises releasing the structure from the  
3 substrate at the free end to form a cantilever.

1 32. The method of claim 30, wherein the signal line is a first  
2 signal line and further comprising:  
3 coating less than the entire portion of the second  
4 structure with an insulating material and coating the insulating  
5 material with a conductive material that is patterned to a  
6 second signal line.